XXXII. *Obſervations on the Gillaroe Trout, commonly called in* Ireland *the Gizzard Trout, by* John Hunter, *F. R. S.*

Redde, March 17, 1774.

ONE of the digeſtive organs of this trout being ſo very remarkable as to have given name to the fiſh, and to be looked upon as its diſtinguiſhing characteriſtic; it will be neceſſary, to take a general view of the varieties in the digeſtive organs of animals, to determine what place the ſtomach of this particular trout holds among them, and alſo to throw ſome light upon the queſtion, whether its reſemblance to a gizzard be ſuch, as to render the name of *gizzard trout* a proper appellation.

To begin with ſome general facts: the food of animals may be divided into two kinds, ſuch as does, and ſuch as does not, require maſtication, to facilitate the digeſtion. All animal food is of this latter kind. But grain, and many other ſubſtances which ſerve for aliment, require a previous grinding or trituration; and therefore thoſe animals which live on ſuch food, are furniſhed with organs for that purpoſe. Granivorous quadrupeds have the two powers, viz. maſtication and digeſtion, ſeparate or diſtinct from one another; the firſt being exerted by a ſet of teeth of a particular form,

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form, which ſerve as ſo many grindſtones for reducing their food to a powder, before it be conveyed into the ſtomach for digeſtion; and when ſo prepared, it is, with regard to the digeſtive power, become ſimilar to animal food: therefore in many ſuch animals the ſtomach is ſimilar to that of the carnivorous; and whenever the ſtomach in granivorous quadrupeds differs from this general rule, there is a ſingularity in the operations of digeſtion. Such birds as live upon this kind of food, for the digeſtion of which trituration is indiſpenſably neceſſary, have the powers of maſtication and digeſtion united in one part; which is of a peculiar ſtructure for that purpoſe; this is the *gizzard.* In granivorous birds therefore one ſingle organ anſwers both to the teeth and ſtomach of granivorous quadrupeds, and conſequently the gizzard alone of birds will point out the food of the ſpecies as clearly, as the teeth and ſtomach together do in other animals, in which the two offices of maſtication and digeſtion are not joined together in the ſame part.

As it appears then to be the difference of the ſtomachs only, that fits birds for their different kinds of food, it is evident that every gradation of ſtomach muſt be found among them, from the true *gizzard* which is one extreme, to the more *membranous ſtomach* which is the other; ſince the food of different ſpecies is of every different kind, from the hardeſt grain, to the ſofteſt animal matter. In conſequence of this, it muſt be as difficult to determine the exact limits of the two different conſtructions, to which the names of *gizzard* and *ſtomach* ſpeci-

ſpecifically belong, as, in any other caſe, to diſtinguiſh proximate ſteps in the ſlow and imperceptible gradations of nature.

The two extremes of true gizzard, and membranous ſtomach, are eaſily defined; but they run ſo into each other, that the end of one and the beginning of the other are quite imperceptible. Similar gradations are obſerved in the food; the kinds ſuited to the two extremes mixing together in different proportions, adapted to the intermediate ſtates of ſtomach.

A true *gizzard* is compoſed of two ſtrong muſcles placed oppoſite, and acting upon each other, as two broad grindſtones. Theſe muſcles are joined together at their ſides by a middle tendon, into which the muſcular fibres are inſerted, and which forms the narrow anterior and poſterior ſides of the flat quadrangular cavity, in which the grinding is performed. The upper end of this cavity is filled up by the termination of the *œſophagus*, and the beginning of the inteſtine. The lower end conſiſts of a thin muſcular bag connecting the edges of the two muſcles together.

By a ſoft flexible ſubſtance being thus interpoſed between the two ſtrong grinding muſcles, a double advantage is gained; for whilſt it gives an eaſy paſſage to the *œſophagus* and gut above, it allows of that free motion of the grinding ſurfaces on each other, which is neceſſary for the comminution of the food. The half-muſcular half-membranous bag, which is fitted on to the lower end of the cavity, at the ſame time that it ſerves for a reſervoir, is perhaps the only part which has the power of digeſtion, and therefore that is to be called the true *ſtomach*. In this caſe then we have ſome diſtinction between the two grand offices of maſtication and digeſtion.

The two flat lateral ſides of the grinding cavity are lined with a thick horney ſubſtance ſimilar to a hard and thick cuticle: the narrow anterior and poſterior tendinous parts are alſo lined with a cuticle, but not ſo ſtrong as the former: this horney ſubſtance is gradually loſt at one end in a very thin cuticle, which lines the paſſages of the *oeſophagus* and inteſtine for a little way; and at the other end is alſo ſimilarly loſt in the membranous bag, or true ſtomach.

The two large muſcles may be conſidered as a pair of jaws, whoſe teeth are taken in occaſionally, being ſmall rough ſtones or pebbles which the animal ſwallows: and from the feeling on the tongue, it can diſtinguiſh ſuch of theſe as are proper, from thoſe which are ſmooth or otherways unfit for the purpoſe, which laſt it inſtantly drops out of its mouth.

Some birds, with gizzards, have a *craw* or *crop* alſo, which ſerves as a reſervoir, and for ſoftening the grain; but as all of them have not this organ, it is not to our preſent purpoſe.

There are other animals beſides that claſs of birds, which maſticate their food in their ſtomach, but their teeth are placed there by nature: CRABS and LOBSTERS are of this kind

The gradation from *gizzard* to *ſtomach* is made by the muſcular ſides becoming weaker and weaker, and the true ſtomachic or gaſtric part proportiona-

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bly larger and larger, in the ſucceſſive order of birds, till at length it conſtitutes the whole of the organ; and the food keeps pace with this change, varying gradually from vegetable to animal. In one point of view, therefore, food may be conſidered as a firſt principle, with reſpect to which the digeſtive powers, with their appendages, are as ſecondary parts, being adapted to and determined by the food, as the primary object.

We find then that in granivorous animals of all ſorts, there is an apparatus for the maſtication of the food, although of different kinds and differently placed. But in true carnivorous animals of whatever tribe, maſtication is not neceſſary, and therefore they have no apparatus for that purpoſe. The teeth of ſuch quadrupeds, as are carnivorous, ſerve chiefly to procure food and prepare it for deglutition. The ſame thing holds in the true carnivorous bird, the office of whoſe beak and talons is to procure the aliment, and fit it for deglutition, correſponding in this reſpect to the teeth of the others. Applying this to fiſh, it ſeems, at firſt ſight, that there is no occaſion in them for that variety of ſtructure in the digeſtive organs, which is found in the beforementioned quadrupeds and birds; the food of fiſh being principally of one ſort, namely, animal, which however with regard to the digeſtive powers, is to be diſtinguiſhed into two kinds, viz. common ſoft fiſh and ſhell-fiſh. Such fiſh as live on the firſt kind, have like the carnivorous quadrupeds and birds, no apparatus for maſtication; their teeth being intended merely for catching the food and fitting it to be ſwallowed.

ſwallowed. But the ſhells of the ſecond kind of food render ſome degree of maſticating power neceſſary, and accordingly we find in certain fiſh a ſtructure ſuited to this purpoſe.

Thus the mouth of the WOLF-FISH is almoſt paved with teeth, by means of which he can break any ſhells to pieces, and ſo effectually diſengage the food for digeſtion, that though he lives upon ſuch hard food, his ſtomach does not differ from that of other fiſh: the organs of maſtication and digeſtion therefore in this animal exactly correſpond to thoſe of many granivorous quadrupeds.

Other fiſh, on the contrary, approach nearer to the ſtructure of birds, in having their ſtomach furniſhed with ſome degree of maſticating power; but it is very imperfect, compared with that of the gizzard of fowls, though perhaps the difference is ſuch only as the difference of food will properly allow: for in fiſh who have this power, the food being ſtill animal, and but imperfectly covered with the ſhell, it perhaps wants only to be broken; whereas that of granivorous birds requires to be ground into a kind of meal.

Of all the fiſh I have ſeen, the MULLET is the cleareſt inſtance of this ſtructure; its ſtrong muſcular ſtomach being evidently adapted, like the gizzard of birds, to the two offices of maſtication and digeſtion. The ſtomach of the fiſh now before us holds the ſecond place.

But ſtill neither of thoſe ſtomachs can be juſtly ranked as *gizzards*, ſince they want ſome of the moſt eſſential characters, *viz.* a power and motion fitted for grinding, and the horney cuticle. The ſtomach

of

of the GILLAROO TROUT is however more circumſcribed than that of moſt fiſh, better adapted for ſmall food, and endued with ſufficient ſtrength to break the ſhells of ſmall ſhell fiſh; which will moſt probably be beſt done by having more than one in the ſtomach at a time, and alſo by taking pretty large and ſmooth ſtones into the ſtomach, which will anſwer the purpoſe of breaking; but not ſo well that of grinding; nor will they hurt the ſtomach as they are ſmooth, when ſwallowed: but this ſtomach can ſcarcely poſſeſs any power of grinding, as the whole cavity is lined with a fine villous coat, the internal ſurface of which appears every where to be digeſtive, and by no means fitted for maſtication.

The ſtomach of the ENGLISH TROUT is exactly of the ſame ſpecies with the GILLAROO, but its coat is not ſo thick by $\frac{2}{3}$ (*a*). How far this difference in thickneſs of ſtomach is ſufficient to make a diſtinct ſpecies, or barely a variety of the ſame, is only to be determined by experiment (*b*).

The *oeſophagus* in the trout is conſiderably longer and ſmaller than in many other claſſes of fiſh.

The inteſtines are ſimilar to thoſe of the ſalmon, herring, ſprat, &c.

(*a*) The Engliſh trout ſwallows ſhell-fiſh, and alſo pretty large ſmooth ſtones, which ſerve as a kind of ſhell-breaker.

(*b*) *Viz.* Take ſome Gillaroo trout, male and female, and tranſplant them into ſome other water where there are no trout, to ſee if they continue the ſame.

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The *pancreas* is appendiculated (*c*).

The teeth ſhew them to be fiſh of prey.

So far as we are led to determine by analogy, we muſt not conſider the ſtomach of this fiſh as a *gizzard*, but as a true *ſtomach*.

(*c*) I chuſe to give this name to the part from its appearance.